DOCUMENT RESUME

ED 222 242 PS 013 087

AUTHOR Kamphaus, Randy W.; And Others
TITLE A Cross-Validation Study of Sequential-Simultaneous Processing at Ages 2 1/2-12 1/2 Using the Kaufman Assessment Battery for Children (K-ABC).
PUB DATE Aug 82
NOTE 16p.; Paper presented at the Annual Meeting of the American Psychological Association (90th, Washington, DC, August 23-27, 1982).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Cognitive Processes; Elementary Education; *Elementary School Students; Factor Analysis; *Measures (Individuals); National Surveys; Performance Factors; *Preschool Children; *Test Validity
IDENTIFIERS *Kaufman Assessment Battery for Children; Sequential Processing; Simultaneous Processing

ABSTRACT

The development of two types of mental processing (sequential and simultaneous) in preschool and elementary children was examined in this study. Specifically, the aims of the study were to develop a revised set of tasks based upon previous findings (Naglieri, Kaufman, Kaufman, & Kamphaus, 1981; Kaufman, Kaufman, Kamphaus, & Naglieri, in press) in order to (1) provide independent cross-validation of the existence of sequential and simultaneous processes in children by factor analyzing this battery of tasks for a large, nationally representative sample; (2) assess the construct validity of the Kaufman Assessment Battery for Children (K-ABC); and (3) study developmental changes in the two processes across the preschool and elementary school range. A national sample of 2,000 children from 22 states participated in the study; participants ranged in age from 2 1/2 to 12 1/2 years and were stratified by sex, race, socioeconomic status, geographic region, and community size. The subjects were first divided into 11 age groups (100 children each at ages 2 1/2 and 12 1/2, and 200 children for every 1-year interval from 3 through 11) and then were individually administered the 10 mental processing subtests of the K-ABC. Analyses of the 11 groups produced two significant factors per age with clear-cut sequential and simultaneous dimensions emerging for each group. The results expanded current knowledge of the nature of the processing dichotomy and supported the construct validity of the K-ABC. (Author/MP)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED222242

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
X This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

A Cross-Validation Study of Sequential—Simultaneous Processing at Ages 2½—12½ Using the Kaufman Assessment Battery for Children (K-ABC)

Randy W. Kamphaus
American Guidance Service
Circle Pines, Minnesota

Alan S. Kaufman
California School of
Professional Psychology
San Diego

Nadeen L. Kaufman
California School of
Professional Psychology
San Diego

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Randy W. Kamphaus
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

PS013087

Running Head: Sequential—Simultaneous Processing

Paper presented at APA, 1982, Washington, D. C.

ABSTRACT

A Cross-Validation Study of Sequential—Simultaneous Processing at Ages 2½—12½ Using the Kaufman Assessment Battery for Children (K-ABC)

The development of sequential and simultaneous processing, two types of mental processing posited by Luria and his followers (Das, Kirby, Jarman), cerebral specialization researchers, and cognitive psychologists, was examined in a factor-analytic investigation of 10 new tasks from the K-ABC for 2,000 children. The subjects were a representative national sample stratified by sex, race, socioeconomic status, geographic region, and community size, based upon 1980 U.S. Census statistics. Analyses of 11 age groups produced two significant factors per age with clear-cut sequential and simultaneous dimensions emerging for each group. The results expanded current knowledge of the nature of the processing dichotomy and supported the construct validity of the K-ABC.

A Cross-Validation Study of Sequential—Simultaneous Processing at Ages 2½—12½ Using the Kaufman Assessment Battery for Children (K-ABC)

Statement of the Problem

Two types of intelligence have been identified by numerous researchers in diverse areas of neuropsychology and cognitive psychology. One type of problem solving involves linear, analytic, temporal, and sequential processing; the other demands gestalt, holistic, spatial, and simultaneous syntheses. This mental processing dichotomy has been labeled successive—simultaneous (Das, Kirby, & Jarman, 1975, 1979; Luria, 1966), serial-parallel or sequential-multiple, (Neisser, 1967), analytic-holistic (Ornstein, 1972), controlled-automatic (Shiffrin & Schneider, 1977), and propositional-appositional (Bogen, 1975), to name but a few. Theorists disagree about the two types of intelligence or information processing. From neuropsychology, for example, the Luria-Das approach attributes successive processing to the fronto-temporal areas and simultaneous processing to the occipital-parietal regions; in contrast, cerebral specialization researchers rotate Luria's point of view by 90 degrees and speak of left-brain (analytic-sequential) vs. right-brain (gestalt-holistic) functioning. Nevertheless, of extreme interest is the convergence regarding the processing dichotomy that has emerged from so many different, independent laboratory and clinical settings.

Das et al (1975, 1979) have conducted and summarized numerous factor-analytic investigations of the two types of mental functioning. They report successive and simultaneous factors for a wide diversity of populations including mentally retarded, learning disabled, high

and low socioeconomic status, white Canadians, native Canadians, and high-caste children from India. Virtually all of these studies have come from Das, his colleagues, or students, and have used the same half dozen or so tasks in Das' successive—simultaneous test battery. There have been only a few independent cross-validations, producing negative (Vernon, Ryba, & Lang, 1978) as well as positive (Naglieri, Kaufman, Kaufman, & Kamphaus, 1981; Kaufman, Kaufman, Kamphaus, & Naglieri, in press) results. In addition, other than Molloy's (1973) investigation of children in both grade 1 and grade 4, there do not seem to be studies which have systematically evaluated developmental aspects of the successive and simultaneous factors across the preschool and elementary school age range.

The aims of this study were to develop a revised set of tasks based upon previous findings (Naglieri, Kaufman, Kaufman, & Kamphaus, 1981; Kaufman, Kaufman, Kamphaus, & Naglieri, in press) in order to: (1) provide independent cross-validation of the existence of sequential and simultaneous processes in children by factor analyzing this battery of tasks for a large nationally representative sample, (2) assess the construct validity of the Kaufman Assessment Battery for Children (K-ABC, Kaufman & Kaufman, in press), and (3) study developmental changes in the two processes across the preschool and elementary school range.

Subjects

The sample was comprised of 2,000 children ages 2½—12½ years. Children from 22 states were included in the stratified national sample based upon 1980 U.S. Census statistics. The sample was stratified at

each age by sex, race, socioeconomic status (parent's educational attainment), geographic region, and community size. Equal numbers of males and females were included at each age and the racial representation of the sample was 72.5% white, 15.6% black, 7.8% Hispanic, and 4.1% American Indian, Asian, or other races. There were 11 age groups as follows: 100 children each at ages 2½ and 12½, and 200 children for every one-year interval from 3 through 11 years.

Instruments

The standardization edition of the Kaufman Assessment Battery for Children (K-ABC, Kaufman & Kaufman, in press) was administered in Spring and Summer, 1981. All 10 subtests were administered to each child. The six achievement subtests of the K-ABC were also administered to each child but were excluded from this study. The 10 mental processing subtests in the standardization edition of the K-ABC are described below.

Hand Movements (Ages 2½—12½)

Performing a series of hand movements in the same sequence as the examiner performed them.

Number Recall (Ages 2½—12½)

Repeating a series of digits in the same sequence as the examiner said them.

Word Order (Ages 4—12½)

Touching a series of pictures in the same sequence as they were named by the examiner.

Magic Window (Ages 2½—4)

Identifying a picture which the examiner exposes by moving it past a narrow slit or "window," making the picture only partially visible at any one time.

Face Recognition (Ages 2½—4)

Selecting from a group photograph the one or two faces that were exposed briefly in the preceding photograph.

Gestalt Closure (Ages 2½—12½)

Naming the object or scene pictured in a partially completed "inkblot" drawing.

Triangles (Ages 4—12½)

Assembling several identical triangles into an abstract pattern that matches a model.

Matrix Analogies (Ages 5—12½)

Selecting the picture or abstract design which best completes a visual analogy.

Spatial Memory (Ages 5—12½)

Recalling the placement of pictures on a page that was exposed briefly.

Photo Series (Ages 6—12½)

Placing photographs of an event in chronological order.

Data Analysis

A principal components analysis with 1's in the diagonals and without iterations was computed for each of the 11 age groups. Principal factor analysis with varimax rotation was also conducted for each of the age groups. Squared multiple correlations were used in the diagonals as initial estimates of communalities followed by iterations.

Results and Discussion

Consistent with previous findings, two factors representing the sequential and simultaneous dimensions emerged for every age group. These two factor varimax rotated solutions are presented in Table 1. The sequential factor was highlighted by strong loadings, across the age range, by Number Recall and Word Order; the simultaneous factor by Face Recognition, Triangles, Gestalt Closure, Spatial Memory, Magic Window and Matrix Analogies.

Photo Series, a subtest having equivocal loadings at some ages in a previous study by Kaufman et al (1981) appeared as a very strong measure of simultaneous processing with this larger, more representative sample. The mean factor loading for Photo Series was .26 on the sequential factor and a strong .69 on the simultaneous factor, making this subtest one of the best measures of simultaneous processing. This finding also lends support to the Das et al (1979) notion that the mental processing required by the task is what determines whether it is sequential or simultaneous, not its content, or its presentation or response made. Photo Series, for instance, "looks" like a sequential

task because of the fact that the child must place pictures of events in chronological order in order to solve the items correctly. The sizable factor loadings with subtests that have been shown to be simultaneous in previous investigations (Naglieri et al, 1981; Kaufman et al, 1981) support the hypothesis that in order to solve a Photo Series item correctly, the child must synthesize the pictures into a mental whole before responding by placing them in chronological order.

Hand Movements was the only subtest which showed some inkling of a developmental trend in its factor loadings. Although Hand Movements had higher loadings on the sequential factor at six of the eleven age groups, its loadings on the sequential factor were considerably higher at the first three (preschool) age levels.

The relative size of the sequential and simultaneous factors was consistent across the age range as is shown in Table 1. With the exception of age three where the sequential factor accounted for more of the common factor variance than the simultaneous factor, on the average the simultaneous factor consistently accounted for about 50 to 60% of the common factor variance to 40 to 50% for the sequential factor.

Also worthy of note are the loadings of each test on the hypothetical g factor, defined in this investigation as the loadings of each test on the unrotated first factor yielded by the principal components analysis. As is evident from Table 2, the first factor loadings of each subtest were fairly consistent across the age range. The strongest measures of g with mean loadings of .70 and above were Photo Series, Triangles, and Matrix Analogies. The two sequential tests which were the best measures of g were Word Order ($\bar{X}$ = .68) and Hand Movements ($\bar{X}$ = .65). Of the tests administered to preschoolers, Magic Window had

the highest average loading on the g factor across the age range where it is administered. On the other hand, Gestalt Closure and Number Recall were equally strong measures of g as Magic Window at the preschool level. Interestingly, at the preschool level Number Recall, a sequential test, had the highest average loading on the g factor of any test administered to children ages 2½—4.

Conclusions

The current study lends solid support to the research of Das and his colleagues on the sequential—simultaneous processing model. Moreover, the data presented provide strong evidence of the construct validity of the Kaufman Assessment Battery for Children (K-ABC), in terms of the ability of this test to assess sequential and simultaneous mental processing abilities.

Notes

Requests for reprints should be sent to Randy W. Kamphaus, Research Associate, Test Division, Publishers' Building, Circle Pines, MN 55014.

TABLE 1

Varimax Rotated Factor Loadings* of K-ABC Subtests by Age

Subtest	Factor	Age in Years 2½	3	4	5	6	7	8	9	10	11	12	Mean Factor Loadings
Magic Window	Seq.	16	17	30									21
	Sim.	80	62	47									63
Face Recognition	Seq.	36	23	24									28
	Sim.	34	37	50									40
Hand Movements	Seq.	60	57	62	26	47	39	35	34	37	41	35	43
	Sim.	11	19	25	51	33	32	44	47	43	38	56	36
Gestalt Closure	Seq.	36	20	14	22	12	07	03	07	04	07	04	12
	Sim.	48	50	79	63	55	53	48	57	52	50	44	54
Number Recall	Seq.	60	74	58	62	78	83	77	95	92	74	54	73
	Sim.	38	31	16	24	15	13	12	07	13	09	27	19
Triangles	Seq.			36	21	17	22	13	17	18	25	26	22
	Sim.			47	74	75	71	67	78	69	73	70	69
Word Order	Seq.			69	89	79	75	78	53	69	63	96	75
	Sim.			32	34	24	36	25	29	24	26	10	27
Matrix Analogies	Seq.				32	30	25	23	28	23	41	36	30
	Sim.				54	45	42	67	59	62	58	70	57
Spatial Memory	Seq.				30	27	26	22	16	27	36	09	24
	Sim.				68	63	54	52	71	54	56	58	60
Photo Series	Seq.					25	36	26	20	22	17	36	26
	Sim.					76	67	66	67	75	66	63	69
Percent of Common Factor Variance	Seq.	46.6	52.2	49.9	41.6	43.5	46.5	41.7	36.6	42.6	42.1	42.3	
	Sim.	53.4	47.8	50.1	58.4	56.5	53.5	58.3	63.4	57.4	57.9	57.7	

*Decimal points are omitted. Percent of common factor variance was computed by dividing the rotated eigenvalue by the sum of the communalities.

TABLE 2

Unrotated First Factor Loadings* and Communalities of K-ABC Subtests by Age

Subtest	First Factor Loadings & Communalities	Age in Years											Mean First Factor Loadings & Communalities
		2½	3	4	5	6	7	8	9	10	11	12	
Magic Window	Fac.	71	65	64									67
	Com.	29	19	26									25
Face Recognition	Fac.	63	58	61									61
	Com.	19	14	30									21
Hand Movements	Fac.	59	65	68	65	63	59	65	65	65	63	73	65
	Com.	18	24	32	29	31	24	31	32	30	28	41	29
Gestalt Closure	Fac.	71	63	67	70	58	52	48	60	52	51	45	58
	Com.	28	17	35	37	30	22	20	29	22	23	19	26
Number Recall	Fac.	76	76	60	63	63	65	56	51	62	56	60	63
	Com.	32	32	26	42	46	47	43	37	49	31	36	38
Triangles	Fac.			67	76	73	72	68	79	72	76	76	73
	Com.			34	46	45	43	37	52	41	46	49	44
Word Order	Fac.			75	78	69	78	66	58	64	64	62	68
	Com.			41	56	50	56	49	37	49	35	44	46
Matrix Analogies	Fac.				70	62	57	73	72	70	76	81	70
	Com.				35	29	21	41	38	36	43	54	37
Spatial Memory	Fac.				78	73	66	63	75	68	73	59	69
	Com.				47	40	31	28	45	31	39	34	37
Photo Series	Fac.					78	78	74	74	77	68	77	75
	Com.					51	48	41	43	48	36	47	45

*Decimal points are omitted.

References

Bogen, J.E. Some educational aspects of hemispheric specialization. UCLA Educator, 1975, 17, 24-32.

Das, J.P., Kirby, J., & Jarman, R.F. Simultaneous and successive syntheses: An alternative model for cognitive abilities. Psychological Bulletin, 1975, 82, 87-103.

Das, J.P., Kirby, J., & Jarman, R.F. Simultaneous and successive cognitive processes. New York: Academic Press, 1979.

Kaufman, A.S., Kaufman, N.L., Kamphaus, R.W., & Naglieri, J.A. Sequential and simultaneous factors at ages 3—12½: Developmental changes in neuropsychological dimensions. Clinical Neuropsychology, in press.

Kaufman, A.S., & Kaufman, N.L. Kaufman Assessment Battery for Children (K—ABC). Circle Pines, Minnesota: American Guidance Service, in press.

Luria, A.R. Human brain and psychological processes. New York: Harper & Row, 1966.

Molloy, G.N. Age, socioeconomic status, and patterns of cognitive ability. Unpublished doctoral dissertation, University of Alberta, 1973.

Naglieri, J.A., Kaufman, A.S., Kaufman, N.L., & Kamphaus, R.W. Cross-validation of Das' simultaneous and successive processes with novel tasks. Alberta Journal of Educational Research, 1981, 27, 264-271.

Neisser, U. Cognitive psychology. New York: Appleton-Century-Crofts, 1967.

Ornstein, R. The psychology of consciousness. San Francisco: W. H. Freeman, 1972.

Shiffrin, R.M., & Schneider, W. Controlled and automatic human information processing: II. Perceptual learning, automatic attending, and a general theory. Psychological Review, 1977, 84, 127-190.

Vernon, P.E., Ryba, K.A., & Lang, R.J. Simultaneous and successive processing: An attempt at replication. Canadian Journal of Behavioral Science, 1978, 10, 1-15.